The Automotive Industry and the Transition to Electric Mobility in Italy†

Lorenzo Cresti[a‡], Angelica Sbardella[a], and Maria Enrica Virgillito[b†]

[a] Enrico Fermi Research Center, Rome, Italy

[b] Institute of Economics, Scuola Superiore Sant'Anna, Pisa, Italy

Abstract

Which will be the economic costs of inaction if the Italian automotive industry fails to transition towards electric mobility? In the following, we simulate an Input-Output economy, focusing on the automotive industry. Specifically, we evaluate the economic impacts of demand shocks on employment and value-added in the Italian automotive sector and its supply chain. To do so, we project the effects of demand losses from 2021 to 2030. This approach allows us to capture intersectoral dependencies, illustrating how changes in final demand for cars propagate through production processes, affecting both direct and indirect economic activities. The simulation results predict that the industry could lose between 70% and 80% of its direct employment and value-added. The social costs of inaction are also examined through the simulation of a redundancy scheme (*Cassa Integrazioni Guadagni*), that accounts for 2 billion USD in fiscal stimulus. Finally, we conclude by presenting an alternative proposal for industrial policies aimed at mitigating these impacts and strengthening the industry and its supply chain.

† This report has been commissioned by ECCO and Transport and Environment Italy. The authors thank Massimiliano Bienati, Andrea Boraschi, and Luca Poggi for the fruitful discussions, and the participants to the Chatham House meeting "L'automotive italiana tra crisi e transizione" held on November 26, 2024 at ECCO headquarter in Rome for the industry's insights. The views set out in this paper are those of the authors only and does not necessarily reflect the views of ECCO, Transport and Environment Italy, or other associated parties.

‡ The views expressed in this document are purely personal and may not under any circumstances be regarded as stating an official position of the European Parliament. Lorenzo Cresti's contribution was limited to the initial phase of the consultancy, prior to the start of the work in the European Parliament.

Introduction

The automotive industry has historically been a flagship of the Italian economy, with its extensive ecosystem of direct production and supporting industries, employing over 340,000 workers in the direct and indirect sectors, and contributing to more than 20 USD billion in value added through domestic production and exports. However, in recent decades, this position of strength has eroded significantly. Italian automotive is now facing critical challenges, including a prolonged decline in the production of final products, which is putting significant strain on all supporting industries. Compounding these difficulties is a decades-long trend of plant closures and phase-outs, further exacerbating the sector's structural vulnerabilities and threatening its competitiveness. Furthermore, Italy is severely lagging in the global race toward electric mobility, a market it has nearly lost. This lack of alignment with the transition to more sustainable vehicles represents both a structural weakness and a missed opportunity to reinvigorate the sector's competitiveness.

To evaluate the economic impacts of demand shocks on employment and value-added in the Italian automotive sector, in this study we propose a model that builds on an Input-Output framework. By relying on the information provided by the OECD ICIO Input-Output tables, this approach captures intersectoral dependencies, illustrating how changes in final demand for cars propagate through production processes, affecting both direct and indirect economic employment and value added. To quantify the costs of inaction in the automotive sector —specifically, the economic consequences of maintaining the sector's prolonged trajectory of decline— the model simulates cascading effects from a non-linear demand shock applied to the economy.

The model projects the economy from 2021 to 2030, simulating non-linear cumulative shocks at each time step: initial shocks affect final demand, value added and employment multipliers in year ($t + 1$), propagating to subsequent years through reduced consumption, employment, and value added. These shocks reflect automotive demand contractions based on the real historical negative growth, i.e. contraction, rates of the Italian automotive industry. Demand is modelled based on the previous year's demand, adjusted by past growth rates. Employment and value added multipliers, which represent jobs or value added generated per unit of production along the production chain, are dynamically adjusted over time as well, in order to capture changes in technical coefficients.

The model integrates the fiscal cost of passive policy interventions, in particular the cost of sustaining a scheme mimicking the *Cassa Integrazione Guadagni* (CIG)[1] public wage subsidy scheme. The scheme partially mitigates demand and employment losses by subsidizing wages, however it has a high social cost to be sustained. In particular, we consider four scenarios: a baseline with no policy intervention, and three scenarios hypothesising high-, medium-, and low-policy intervention, differentiated by the level of reliance on the CIG scheme and the automotive worker re-employment rates.

Our findings underscore extremely severe projected losses by 2030 under the four scenarios, and the automotive sector's importance to the Italian economy highlights the gravity of these losses. In the baseline scenario, where no intervention is implemented, employment losses are expected to reach 75,000 workers, with two-thirds of these occurring in indirect segments, while value added is expected to decline by 5 USD billion, and household consumption and vehicle production halve, showcasing the detrimental impact of inaction. In the high intervention scenario, considering 80% of employment losses under the CIG scheme and only 15% of probability of being re-employed in the economy (low-pressure economy), cumulative employment losses exceed 90,000 workers and CIG imposes a significant fiscal burden of 2 USD billion. The medium intervention scenario, with 50% of employment losses under the CIG schemes and a corresponding 45% probability of being re-employed in the market (medium-pressure economy), achieves moderately lower employment losses (75,000) and value added declines (4.5 USD billion), while cutting fiscal costs to 1 USD billion. Finally, the low intervention scenario, with only 30% of employment losses under the CIG and a corresponding 65% probability of being re-employed in the market (high-pressure economy), reduces employment losses to 65,000 workers and value added declines to 4.2 USD billion, while fiscal costs are contained at 0.5 USD billion.

Once having outlined the results of the model, as well as the costs of inaction for the Italian economy in terms of jobs, value added, and fiscal expenditure, we propose a set of policy interventions aimed at providing an alternative to inaction. More in details, after discussing the existing policy schemes, we lay out an industrial policy framework, including targets, instruments and institutions responsible for the implementation.

[1] *Cassa Integrazione Guadagni* (CIG) is an Italian wage state-funded guarantee scheme that provides temporary income support (80% of the original wage) to displaced workers affected by layoffs or reduced working hours, aiming to mitigate the immediate economic impact of job disruptions.

1 Data and historical calibration

We draw information on the input-output structure of the Italian automotive sector in terms of flows of production, consumption, employment and value added (levels and multipliers) from the OECD Inter-Country Input-Output tables (ICIO),[2] which include 76 countries (+ Rest of the World

To implement the scenario analysis, we rely on different sources of information to calibrate a set of key variables based on historical trends of the Italian automotive sector, ensuring consistency with wage patterns, sector-specific information and labour market conditions.

To restrict our focus only on the production of passenger cars and exclude other types of vehicles, we employ the detailed insights into Italian automotive production trends by type of vehicles provided by the Italian *Associazione Nazionale Filiera Industria Automobilistica* (ANFIA).[3] This dataset categorizes automotive production into segments, including automobiles, buses, and industrial vehicles. For the analysis, the focus is placed on passenger cars, which accounted for 58.1% of total motor vehicle production in 2020.

To model labour costs and the fiscal impacts of the CIG redundancy schemes, we retrieve data on automotive average wages from the OECD Structural Analysis (STAN) database,[4] which covers labour input across industries, including those relevant to the automotive sector, with 2019 serving as a key reference year —as 2019 is the last year for which the information is available in the dataset.

Finally, as this information is not available for Italy, we retrieve the structural automotive unemployment rate from US Labor Force Statistics of the Current Population Survey[5] and revise it upward to be more adherent to Italian labour market conditions.

---

2 The ICIO dataset is fully available at: https://www.oecd.org/en/data/datasets/inter-country-input-out put-tables.html.
aggregate) and 45 sectors (at a 2-digit ISCO Rev. 4 sectoral aggregation, or grouping of 2-digit sectors), from 1995 to 2020. More details on the ICIO Input-Output tables and methodology are provided in the Appendix.

3 The information can be retrieved at: https://www.anfia.it/it/attivita/studi-e-statistiche/automobil e-in-cifre/statistiche-italia/produzione-nazionale/autoveicoli-motor-vehicles.

4 The STAN dataset is fully available at: https://www.oecd.org/en/data/datasets/structural-analysis-dat abase.html.

5 The information can be retrieved at: https://www.bls.gov/cps/.

2 Model description and macro-behavioural rules

We adopt an Input-Output perspective according to Miller and Blair (2009) and Cresti et al. (2023). This approach captures intersectoral dependencies, illustrating how changes in final demand for cars ripple through production processes. These effects impact both direct activities within the automotive sector itself (automotive components firms) and indirect activities (steel, batteries, textile parts etcetera), including those of automotive OEMs and suppliers.

The model projects the economy from 2021 to 2030, simulating non-linear cumulative shocks at each time step and adjusting for policy interventions. Initial shocks affect final demand, value added and employment multipliers in year t+1, propagating to subsequent years through reduced consumption, lower employment, and diminished value added. These shocks reflect contractions in automotive demand and their cascading impacts on employment and economic output, as based on the real figures of the Italian economy between 1995 and 2020. Shocks include not only demand but also employment and value added multipliers, with the aim of embracing the dynamic evolution of technical coefficients of production and value added changes. Contractions in demand reflect a trajectory of declining car production, structurally phased by the Italian economy. Therefore, we implement "a business as usual scenario", considering the lack of positioning of the industry in the electric segment, as the projected trend of Italian car productions in the following ten years. This implies that no other external shock, as increasing penetration from other suppliers, like Chinese exports, are considered, but only the endogenous dynamic evolution of demand, employment and value added multipliers are considered.

Therefore, to describe the shock propagation mechanism, total demand in year $t + 1$ (Y_{t+1}) is modelled as a function of the previous year's demand, evolving dynamically under the historical demand shock rate, i.e. dynamically updated for the average annual growth (or contraction) rate ($\overline{g_Y}$), in the following way:

$$Y_{t+1} = Y_t(1 - \bar{g}_Y)^t \tag{1}$$

where the demand shock rate is derived from historical trends as the average historical growth rate of demand over the period under consideration ($t \in [t_0, T]$ = [1995 – 2020], with):

$$\bar{g}_Y = \frac{\sum_{t=t_0}^{T} g_Y(t, t-1)}{N} \tag{2}$$

where the average annual negative growth rate, (de)growth rate hereafter, in demand stands at 1.5%, and, hereafter, N represents the number of years in the interval [1995-2020].

Employment and value added multipliers, i.e. the amounts of the two variables generated per unit of final production along the vertically integrated sector, as defined in the Appendix, are dynamically updated as well. Therefore, the employment multiplier M^e evolves over time under the growth rate $\overline{g}_M^e$:

$$M_{t+1}^{\mathrm{e}} = M_t^{\mathrm{e}}(1 - \bar{g}_M^{\mathrm{e}})^t \tag{3}$$

Where $\overline{g}_M^e$ is defined as the average rate of change in employment multipliers as follows:

$$\bar{g}_M^{\mathrm{e}} = \frac{\sum_{t=t_0}^{T} g_M^{\mathrm{e}}(t, t-1)}{N} \tag{4}$$

The average annual (de)growth rate in direct employment multipliers stands at 3.3%, while at 1.3% in indirect employment multipliers. Likewise, the value added multiplier (M^{va}) evolves as:

$$M_{t+1}^{va} = M_t^{va}(1 - \bar{g}_{M^{va}})^t \tag{5}$$

where the average growth rate of the value added multiplier is defined as:

$$\bar{g}_M^{\mathrm{va}} = \frac{\sum_{t=t_0}^{T} g_M^{\mathrm{va}}(t, t-1)}{N} \tag{6}$$

The average annual (de)growth rate in direct value added multipliers stands at 1.4%, while at 0.001% in indirect valued added multipliers.

2.1 Policy intervention and scenario analysis

To evaluate the social cost of employment losses, the model mimics the implementation of a passive policy intervention, in particular the Italian *Cassa Integrazione Guadagni* (CIG) redundancy scheme, which partially mitigates demand and employment losses by subsidizing wages, assuming automotive industry wages reduced by 20% and 80% covered by the state.

In the presence of the CIG redundancy scheme, after the shock hits the economy, domestic and foreign demands are differently affected. While foreign demand still follows the shock propagation described in Equation 1, as it is assumed that the drop in demand is caused by the lack of production of new electric vehicles satisfying emerging demand needs, total domestic demand is additionally reduced by a drop in 20% wages. Domestic demand losses are however mitigated by the assumption that a fraction —varying on the basis of different projected policy scenarios— of displaced workers are re-employed in other sectors of the economy (excluding automotive), earning the average economy wage ($\overline{W}$). A structural unemployment rate (U) of 5% is assumed for the automotive sector, persisting even after re-employment efforts. As mentioned above, the rate is adapted from the US Labor Force Statistics of the Current Population Survey, and adjusted upward to better reflect the Italian labour market dynamics. To evaluate the policy's impact, three scenarios are analysed, reflecting varying degrees of policy intervention —high, medium, and low— based on the proportions of workers covered by the CIG scheme and re-employed in other sectors. Probability of being re-employed clearly reflects different status of the economy, which might be more or less capable of attracting displaced workers, what is commonly understood as a low-pressure vis-à-vis a high pressure economy.

The model assumes that wages (W) are fully consumed, and that demand, or consumption, equals production ($W = C = Y$). Therefore, the industry demand generated by workers reemployed at the economy's average wage $\left(Y_{t+1}^{\Re-emp}\right)$, and the loss of demand generated by workers under the CIG scheme $\left(Y_{t+1}^{CIG}\right)$ influence total demand for passenger cars accordingly. The domestic demand in the presence of re-employment and redundancy measures is thus given by:

$$Y_{t+2} = Y_{t+1}(1 - \bar{g}_Y) + Y_{t+1}^{\text{re-emp}} - Y_{t+1}^{\text{CIG}}. \tag{7}$$

In this setting, we sum to the business-as-usual demand loss in $t + 1$, the demand generated by re-employed workers, and the loss of demand/production by unemployed workers under the CIG scheme. Cumulative losses in employment (E) and value added (VA) are computed by summing yearly losses over the relevant time-period $t \in [t_1, \tilde{T}] = [2021{,}2030]$:

$$\begin{aligned} \text{Losses}_{\tilde{T}}^{\text{e}} &= \sum_{t=t_1}^{\tilde{T}} (\text{E}_t - \text{E}_{t-1}) \\ \text{Losses}_{\tilde{T}}^{\text{va}} &= \sum_{t=t_1}^{\tilde{T}} (\text{VA}_t - \text{VA}_{t-1}) \end{aligned} \tag{8}$$

The fiscal cost of the CIG scheme is also estimated cumulatively, with the number of workers covered and the cost of the wage subsidy increasing non-linearly over time. Therefore, by combining the number of workers covered by CIG at time $t + 1$ $\left(\mathrm{E}_{t+1}^{\mathrm{CIG}}\right)$, their sectoral average wages $\overline{W}_{\text{automotive}}$ derived from the STAN OECD statistics, and the wage subsidy rate, which covers 80% of the sectoral average wage, it is estimated as follows:

$$\mathrm{Cost}_{T}^{\mathrm{CIG}} = \sum_{t=t_1}^{\tilde{T}} \mathrm{E}_{t}^{\mathrm{CIG}} \cdot 0.8 \cdot \bar{W}_{\text{automotive}}. \tag{9}$$

As summarised in Table 1, the following analysis envisions four scenarios to analyse the effects of demand shocks in the automotive sector, assuming different re-employment rates into other sectors and the 5% structural unemployment rate for the sector. The baseline scenario assumes no policy intervention, where demand shocks propagate freely through the economy, losses in employment and value added occur directly as a result of decreased demand, without mitigation measures. Note that this scenario only accounts for direct losses in employment and value added, without further propagation effects in consumption. It represents a validity-check scenario of the first-order effects of the shocks. The remaining scenarios instead further reduce demand, incorporating lower wages of workers under the CIG scheme, accounting for second-order effects. A trade-off, however, applies: being the CIG a counter-cyclical policy intervention, the higher the number of workers under the scheme, meaning that the economy runs in a “low pressure” phase, the lower the employment probability in other sectors, with larger second-order effects.

In the first-intervention scenario, high policy intervention is implemented, with 80% of displaced workers supported through the CIG scheme. This scenario assumes limited re-employment opportunities, with 15% of workers transitioning to other sectors and 5% remaining structurally unemployed. The second scenario represents a medium level of policy intervention: 50% of displaced workers are supported by CIG, while 45% are re-employed in other sectors, and 5% remain structurally unemployed. The third scenario is the most market driven as it assumes a low level of policy intervention and the most optimistic re-employment rate: 30% of displaced workers are covered by the CIG scheme, 65% of workers re-employed in other sectors, and 5% remain unemployed. In the following we will refer to these four scenarios respectively as the: baseline, high, medium, and low policy intervention scenarios.

Scenario	**Policy Intervention**	**CIG Coverage (%)**	**Re-employment (%)**	**Structural Unemployment (%)**
Baseline	None	0	0	-
High-intervention	High	80	15	5
Medium-intervention	Medium	50	45	5
Low-intervention	Low	30	65	5

Table 1: Key Features of the policy intervention scenarios.

3 Results

3.1 The Italian Automotive Industry: historical trends and present landscape

Before delving into the scenario analysis, in this section we examine the historical dynamics of the Italian automotive industry, both in terms of production, demand and employment, between 1995 and 2020, as afforded by the I-O tables. This investigation allows us to perform a historically informed calibration.

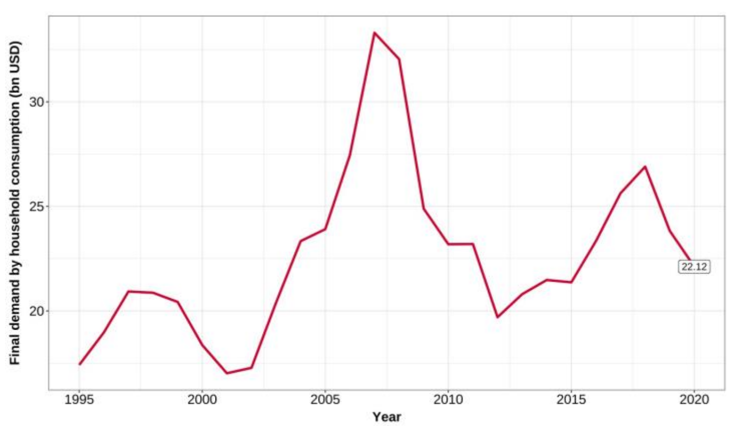

Figure 1: Final household automotive demand (1995-2020).

In Figure 1 we focus on the 1995-2020 trend of final household demand of the automotive sector as a whole. Household demand exhibits a two-phase dynamic centered around the 2008 economic crisis. The pre-crisis period is characterised at first by a stagnating trend, oscillating between 17 and 21 USD billions, and then a steadily increasing trend after 2002, reaching a maximum at more than 35 USD billions. In contrast, the post-crisis period is marked by prolonged reductions in consumption, hitting a minimum of less than 20 USD billions, and displaying a moderate recovery after 2012, with a final value of around 22 USD billions in 2020. However, such figure includes all different types of automotive consumption. On the basis of the information provided by ANFIA, Figure 2 depicts the trends of Italian motor vehicle production, with a four-quadrant breakdown between automobiles, buses, industrial vehicles and total.

At a first glance, from the figure, it is possible to appreciate the structural decline in total production, coupled with a progressive decline of the automotive sector, but also mirroring a clear delay in positioning in the electric vehicle market in more recent years. This trend is in fact driven especially by the important decline of passenger car production, that moved from around 1.5 million units in 1995 to 470,000 units in 2020. Nevertheless, in 2020, car production accounted for 58.1% of total motor vehicle production in Italy –an information we will employ in the following to isolate the demand for cars– underscoring its importance in driving sectoral employment and value added generation.

Moving to the employment dimension, Figure 3 shows the 1995-2020 effective trends of employment in the Italian vertically integrated automotive industry as driven by domestic and foreign household consumption, in the left and right panel respectively, both split across the direct and indirect domestic or foreign components. While domestic household consumption has traditionally been and still is the primary driver of employment activation, with around 200’000 employees, foreign consumption indirect activations have grown steadily over the years, reflecting Italy’s increasing specialisation in producing automotive parts and components in the automotive global value chain.

Moreover, as can be appreciated in Figure 4, while until 2000 the employment multipliers display an increasing trend in the indirect component, they have later declined substantially, nearly halving from 1995 to 2020, reflecting labour saving, technological advancements and increased efficiency in the sector’s production processes.

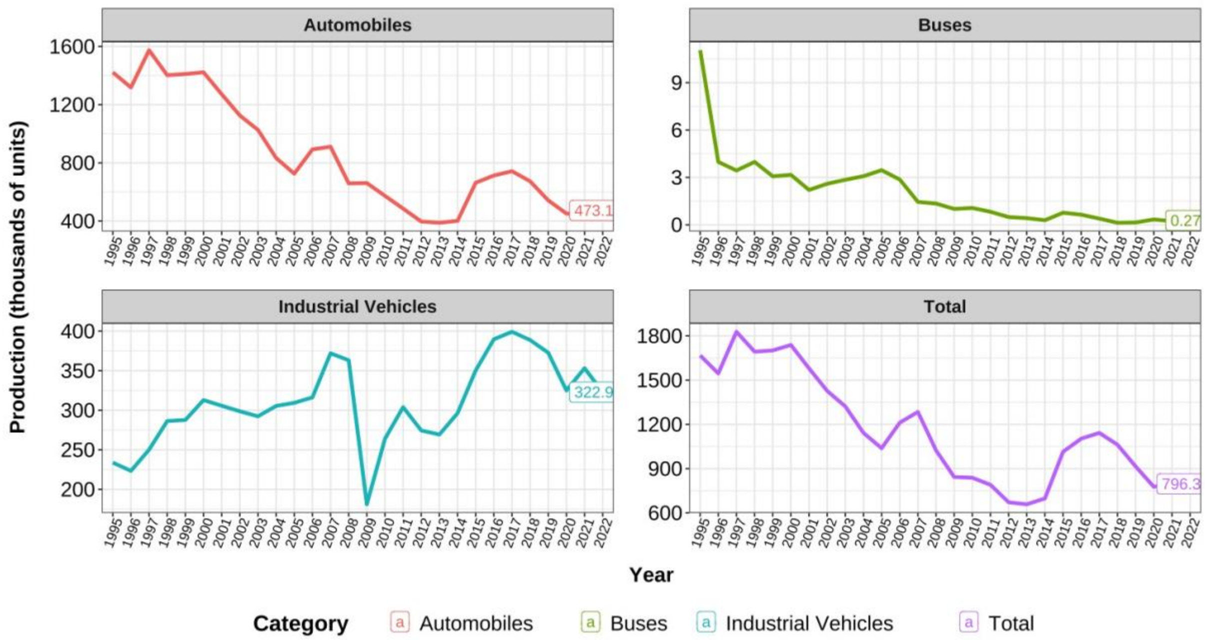

Figure 2: Italian motor vehicle production of automobiles, buses, industrial vehicles and total (1995-2022). Source: own elaboration on ANFIA data.

This sharp reduction in labour intensity indicates a structural shift in the sector and also means that each unit of production supports fewer jobs, amplifying the employment impacts of demand contractions and the sensitivity of employment to demand fluctuations, as shown by the roughly stagnating trend observed after 2005. This information will be further incorporated to project employment multipliers after 2020.

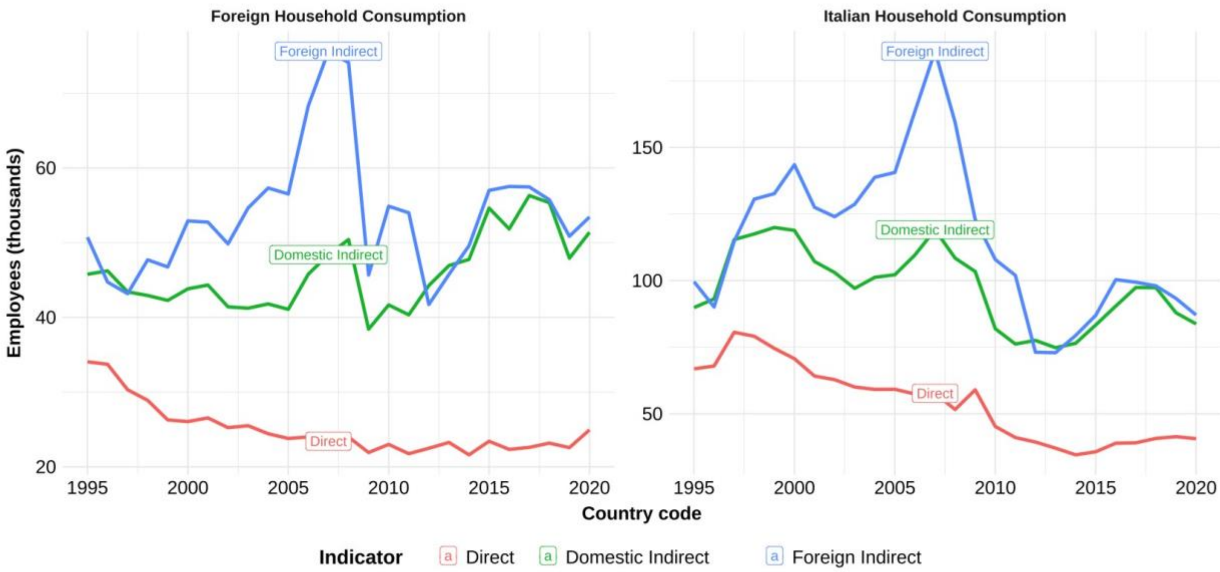

Figure 3: Employment in the Italian vertically integrated automotive industry, as driven by foreign and domestic household consumption, in the left and right panel respectively, both split across the direct and indirect domestic or foreign components (1995-2020).

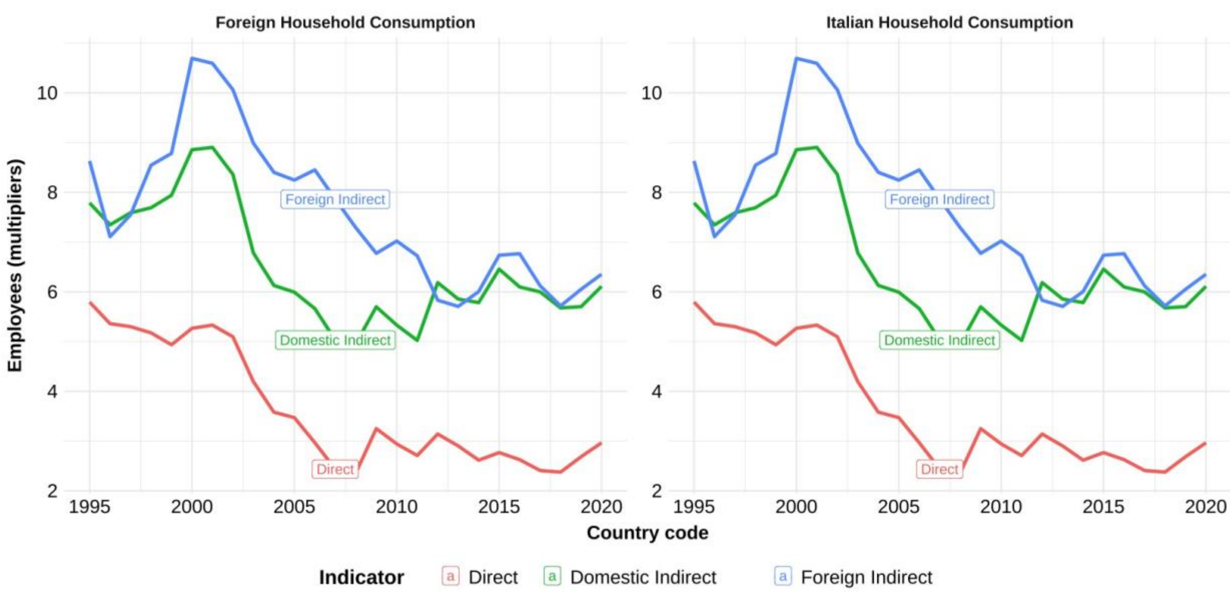

Figure 4: Employment multipliers in the Italian vertically integrated automotive industry, as driven by foreign and domestic household consumption, in the left and right panel respectively, both split across the direct and indirect domestic or foreign components (1995-2020).

3.2 Scenario Analysis

Building on the model and historical calibration detailed in Section 3.1, we simulate the effects of inaction in the Italian automotive industry, i.e. a stalled transition to electric mobility, using a scenario analysis that accounts for non-linear and cumulative demand losses from 2021 to 2030. The simulation employs an Input-Output framework to estimate domestic losses in consumption, employment, and value added across both direct and indirect automotive chains.

To illustrate, we report the details of the effects of the baseline and high policy intervention scenarios, while we then compare the main outcomes and losses under the three scenarios.

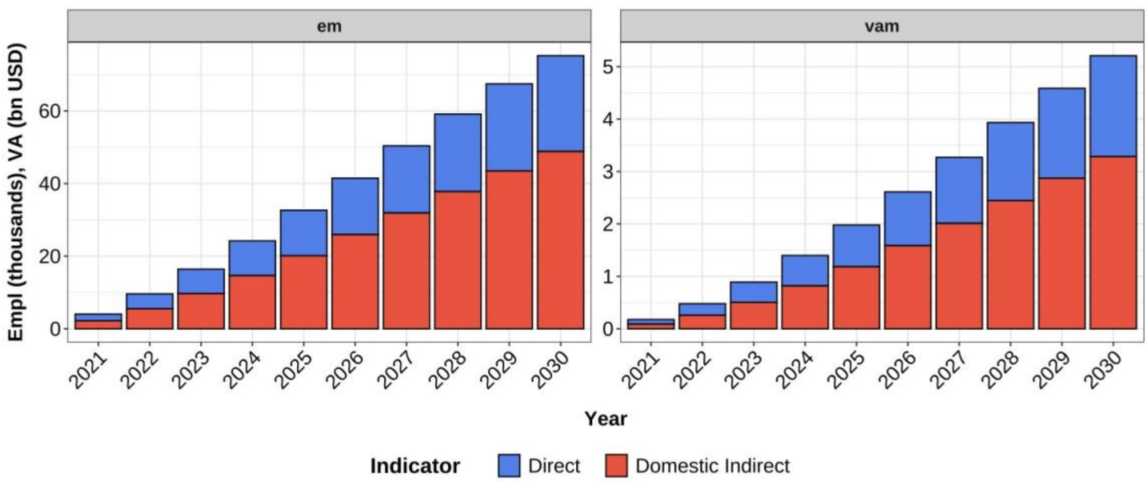

Figure 5: Projected 2021-2030 trends of employment (left panel) and value added (right panel) losses in the baseline scenario.

As shown in Figure 5, under the baseline scenario, demand shocks propagate directly through the economy, causing significant reductions in employment and value added over time, with the domestic indirect automotive sector disproportionately affected. Over ten years, cumulative employment losses amount to 75,000 workers, with approximately 50,000 of these losses originating from the domestic indirect sector. Similarly, cumulative value added losses reach 5 USD billion by 2030, with more than 3 USD billion attributable to the domestic indirect sector.

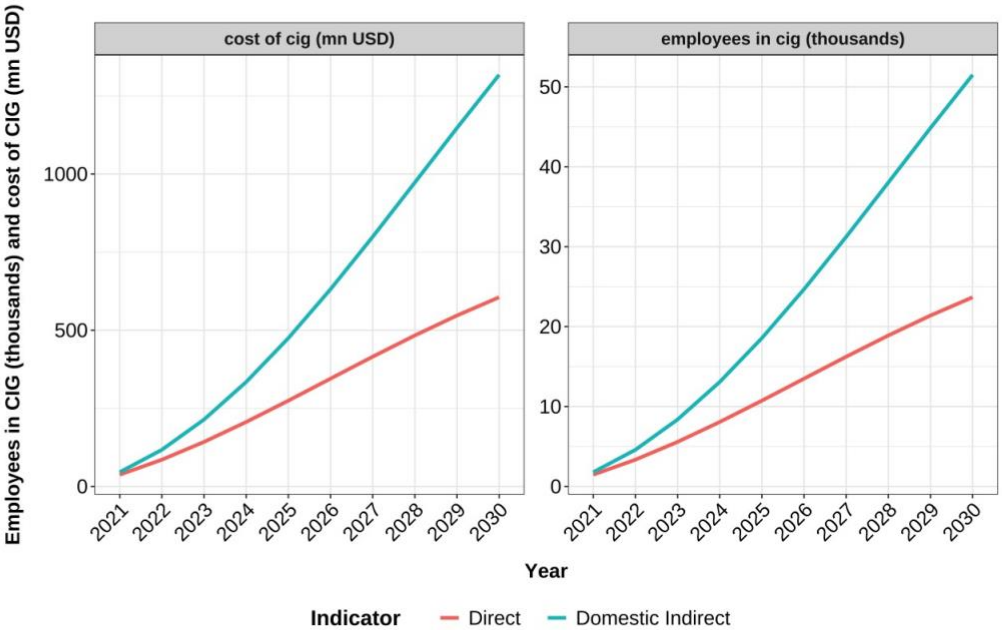

Figure 6: Fiscal costs of the *Cassa Integrazione Guadagni* (CIG) wage subsidy and the number of workers covered in the direct (red line) and indirect (blue line) automotive sectors.

The high policy intervention scenario partly mitigates these impacts by supporting 80% of displaced workers through the CIG scheme, while 15% of affected workers are re-employed in other sectors, and 5% remain structurally unemployed. This intervention absorbs a substantial portion of employment losses but comes with significant fiscal and economic costs. By maintaining displaced workers on CIG, their contributions to household consumption and, consequently, to value added generation are limited, especially as the affected plants are either phased out or shut down. In addition, only a small fraction of displaced workers is reabsorbed in other sectors of the economy and paid at the average wage.

As shown in the right panel of Figure 6, the number of workers under CIG increases from zero in 2021 to over 50,000 in the domestic indirect sector and over 20,000 in the domestic direct sector by 2030. This intervention imposes substantial fiscal burdens, with the cost of CIG rising from zero in 2021 to over 1.5 USD billion for the domestic indirect sector and 600 USD million for the domestic direct sector by 2030 (left panel of Figure 6).

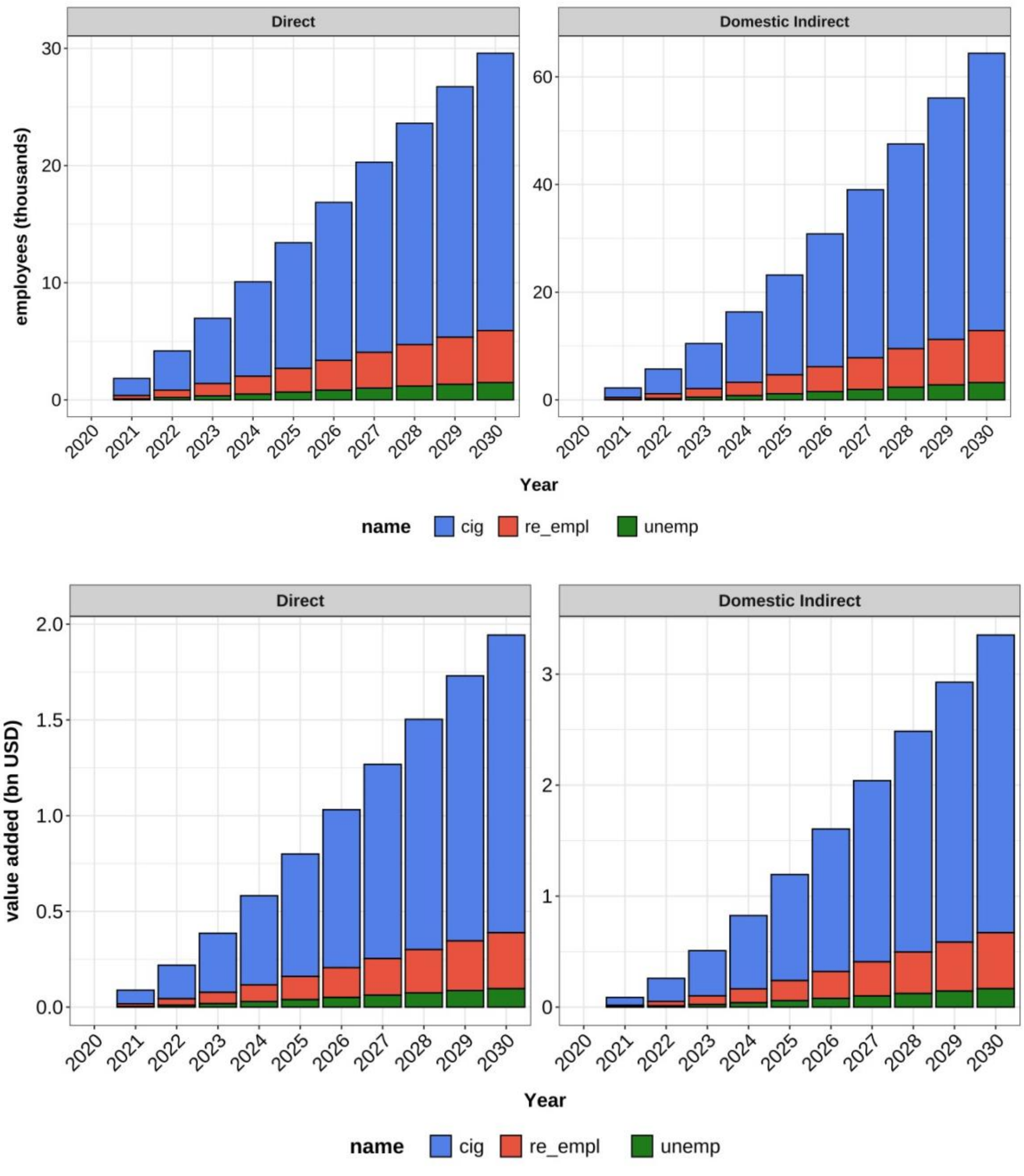

Figure 7: Projected 2021-2030 trends of direct and domestic indirect employment (top panel) and value added (bottom panel) losses in the high policy intervention scenario.

Figure 7 depicts the 2021-2030 trends of cumulative losses in employment and value added, respectively in the top and bottom panels, in the domestic direct and indirect segments as driven by workers covered by the CIG wage subsidy, re-employed in other sectors and structurally unemployed.

The cumulative value added losses continue to grow over time, driven by the rising number of unemployed workers and the increasing reliance on CIG for displaced direct and indirect automotive workers: by 2030, these losses amount to 2 USD billion in the domestic direct segment and over 3 USD billion in the domestic indirect segment. Cumulative employment losses grow over time, with differing proportions across the direct and indirect segments. The CIG scheme absorbs a significant share of these employment losses, accounting for the largest fraction of workers in transition. Over the ten-year period, cumulative losses exceed 90,000 workers, with roughly 30,000 from the domestic direct sector and over 60,000 from the domestic indirect sector.

Domestic household consumption declines progressively but sharply, dropping from approximately 8 USD billion in 2020 to less than 3.5 USD billion by 2030, as shown in the top panel of Figure 8. This more than halved automotive consumption is mirrored by the drop in total car production displayed in the bottom panel of Figure 8, where the declining trend starting at 13 billion USD hits a minimum of around 5.5 billion USD in 2030.

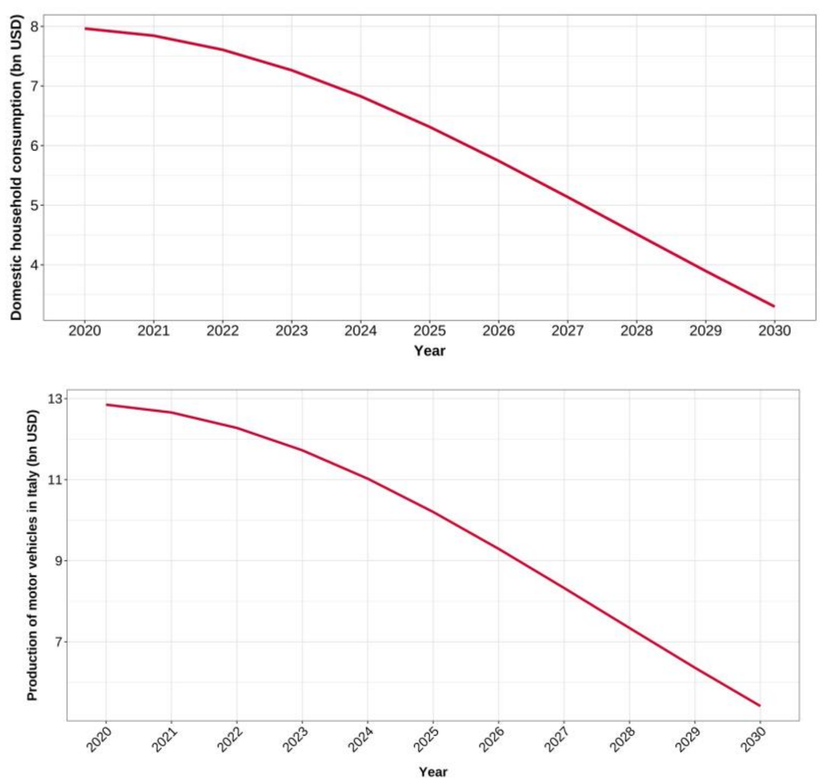

Figure 8: Projected changes in household consumption (top panel) and car production (bottom panel) under the high policy intervention scenario in billion USD.

3.3 Policy intervention scenarios: summary and comparative insights

Tables 2–6 summarise the simulation results across the three policy intervention scenarios, detailing the number of employees under the CIG scheme and the associated fiscal costs, impacts on consumption, production, domestic direct and indirect employment and value added.

(a) CIG Cost – Direct

	High Intervention	Medium Intervention	Low Intervention
CIG Workers (thousands)	23.7	13.2	7.39
CIG Cost (million USD)	606	338	189

(b) CIG Cost – Indirect

	High Intervention	Medium Intervention	Low Intervention
CIG Workers (thousands)	51.5	24.6	12.6
CIG Cost (million USD)	1318	629	321

Table 2: Projected CIG costs (million USD) and number of workers (thousands) covered by the CIG scheme in the direct (a) and indirect (b) automotive sector under the three policy intervention scenarios.

Table 2 shows the CIG cost and the number of workers covered by the CIG scheme in the direct and indirect automotive segments. By construction, the CIG costs and the number of workers benefiting from the wage subsidy differ under the three intervention scenarios. In line with what was discussed above, the indirect effects are more pronounced across all scenarios, with the number of workers supported and the associated costs consistently higher in the indirect sector.

More in detail, in the high-intervention scenario, roughly 24,000 direct and 52,000 indirect workers are supported under the CIG scheme, with total expenditures reaching about 2 USD billion (606 USD million direct, 1.3 USD billion indirect). The medium-intervention scenario reduces coverage to approximately 13,000 direct and 25,000 indirect workers, lowering costs to around 1 USD billion (338 USD million direct, 629 USD million indirect). The low-intervention scenario provides minimal support, covering about 7,400 direct and 13,000 indirect workers at a total cost of roughly 0.5 USD billion (189 USD million direct, 321 USD million indirect).

Relative to the 2020 level of approximately 8 USD billion, even with CIG partially compensating for lost wages, the reduced spending power of affected workers/households contributes to a sharp contraction in domestic demand in all scenarios, with losses ranging from 4.2 to 4.7 USD billion, as displayed in Table 3. In the high-intervention scenario, consumption is projected to decline by 58.6%. The medium-intervention scenario shows a slightly smaller decline of 56.7%, while the low-intervention scenario results in a 55.5% reduction. Lower losses are associated with higher reemployment opportunities.

Household Consumption (Billion USD)

Consumption	**High Intervention**	**Medium Intervention**	**Low Intervention**
2020 Level	7.96	7.96	7.96
2030 Level	3.30	3.45	3.54
2020-2030 Loss	4.66	4.51	4.42
2020-2030 % Loss	58.6%	56.7%	55.5%

Table 3: Projected household consumption (Billion USD) under the three policy intervention scenarios.

Car production projections, as shown in Table 4, reveal substantial and similar declines across all scenarios with respect to the 2020 level of approximately 13 USD billion, with losses ranging between 7.5 and 7.3 USD billion. By 2030, production is estimated to drop to about 5.4 USD billion in the high-intervention scenario, reflecting a 58% loss. In the medium intervention scenario, production decreases to approximately 5.6 USD billion, a 57% decline. The low-intervention scenario results in the smallest reduction, with production falling to around 5.7 USD billion, representing a 56% loss.

Passenger Car Production (Billion USD)

Production	High Intervention	Medium Intervention	Low Intervention
2020 Level	12.9	12.9	12.9
2030 Level	5.41	5.56	5.66
2020-2030 Loss	7.49	7.34	7.24
2020-2030 % Loss	57.9%	56.7%	56%

Table 4: Projected car production (Billion USD) under the three policy intervention scenarios.

Tables 5 (a) and (b) document the projected direct and indirect employment losses across all scenarios relative to the 2020 level of 38,000 employed workers in direct car production and 75,500 workers in the indirect segment. Under the high-intervention scenario, direct employment in the automotive sector is projected to decline by 78% (29,600 jobs lost) by 2030, with indirect employment in related sectors experiencing an even steeper reduction of 82% (64,400 jobs lost). In contrast, the medium-intervention scenario offers a slightly improved outlook, with direct employment shrinking by 70% (26,400 jobs lost) and indirect jobs falling by 63% (49,2000 jobs lost). The low-intervention scenario shows the least severe impacts, with direct employment declining by 65% (24.6 thousand jobs lost) and indirect employment by 53.5% (41,800 jobs lost). We recall that the state intervention is negatively correlated with the re-employment market probability, meaning that the fiscal transfers of the State compensate for an "incapacity" of the market to absorb the labour force expelled, being fiscal transfers usually counter-cyclical. In this respect, one might consider the three scenarios as a low pressure (first), medium pressure (second), high pressure (third) economies, according to the definition provided by the classical contribution by Okun (1979), recently rediscussed in AARONSON et al. (2019). In fact, workers under the CIG scheme negatively contribute to demand generation, consequently the higher their fraction, the higher the losses and the associated social cost.

(a) Direct Employment (thousand workers)

Employment (Direct)	High Intervention	Medium Intervention	Low Intervention
2020 Level	38.1	38.1	38.1
2030 Level	8.52	11.7	13.5
2020-2030 Loss	29.58	26.4	24.6

2020-2030 % Loss	77.6%	69.4%	64.7%

(b) Indirect Employment (thousand workers)

Employment (Indirect)	High Intervention	Medium Intervention	Low Intervention
2020 Level	78.5	78.5	78.5
2030 Level	14.1	29.3	36.7
2020-2030 Loss	64.4	49.2	41.8
2020-2030 % Loss	82%	62.7%	53.5%

Table 5: Automotive employment projections (Thousand Workers) under the three policy intervention scenarios: Direct (a) and Indirect (b).

Finally, Tables 6 (a) and (b) present the projected effect on the direct and indirect components of automotive value added. The sector's loss of value added shows significant declines, with around 1.9 USD billion losses across all scenarios with respect to the 2020 level of 3.1 USD billion. In the high-intervention scenario, direct value added is expected to contract by 63%, with indirect value added decreasing by 58%. While the medium and low-intervention scenarios exhibit slightly smaller but still major reductions in direct value added of around 62%. The losses in indirect value added also persist across scenarios, ranging from 56% to 58%, reflecting the widespread economic effects of diminished production and consumption.

(a) Direct Value Added (Billion USD)

Value Added (Direct)	High Intervention	Medium Intervention	Low Intervention
2020 Level	3.09	3.09	3.09
2030 Level	1.14	1.16	1.17
2020-2030 Loss	1.95	1.93	1.92
2020-2030 % Loss	63%	62.4%	62%

(b) Indirect Value Added (Billion USD)

Value Added (Indirect)	**High Intervention**	**Medium Intervention**	**Low Intervention**
2020 Level	5.79	5.79	5.79
2030 Level	2.44	2.50	2.55
2020-2030 Loss	3.35	3.29	3.24
2020-2030 % Loss	57.9%	56.8%	56%

Table 6: Automotive value added projections (Billion USD) under the three policy intervention scenarios: Direct (a) and Indirect (b).

4 Industrial Policy Framework

The projected scenarios present a stark and dramatic outlook for the automotive industry. Consequently, rather than dwelling on inaction, we emphasize the critical importance of implementing policy measures to mitigate, or even overcome, these negative outcomes. In this section, we outline a set of policy instruments that could serve as a roadmap for interventions aimed at strengthening the industry and its supply chain. Before introducing proposals for new industrial policies, we first discuss the existing policy instruments and initiatives, at the national and EU level: demand incentives, social leasing, development contracts, strategic sectors, and European policies and directives.

4.1 Existing policy initiatives

4.1.1 Demand Incentives

The electric vehicle (EV) market in Italy remains relatively unattractive to manufacturers. As of September 2024, the market share of Battery Electric Vehicles (BEVs) is just 3.84%, significantly lagging behind the double-digit shares observed in most other European countries, with the exception of Spain at 4.84%. For comparison, BEVs account for 31.54% of the market in the Netherlands, 25.60% in Belgium, 17.26% in the UK, 16.8% in France, and 12.72% in Germany. However, there is also a clear relationship between the adoption of BEVs and per capita income, as highlighted in a report by the European Automobile Manufacturers' Association (ACEA).[6] Among the top five best-selling BEV models in Italy are two Tesla models (Model 3 and Model Y), alongside the Volvo XC40, Jeep Avenger, and BMW IX1.Notably, Tesla vehicles, classified in the D segment, account for one-third of all BEVs sold in Italy.

Regional adoption is in fact highest in wealthier areas like Lombardy and Trentino Alto-Adige. Some automotive observers[7] highlight that incentives could potentially drive BEV adoption, as evidenced by the swift exhaustion of €240 million in subsidies allocated by MIMIT in June 2024, within just nine hours. However, the redistributive effect of such measures is likely to be regressive, as electric cars primarily cater to upper-middle-class buyers as, notably, only a quarter of the subsidy recipients belonged to low-income groups.[8]

4.1.2 Social Leasing

Social leasing is an instrument proposed to make BEVs more accessible to low- and middle-income buyers. This scheme offers credit-driven support to demand by allowing users to lease vehicles through manageable monthly payments. Ownership remains with the original equipment manufacturers (OEMs) or distributors, while users sign leasing contracts. France pioneered this demand support approach, offering incentives up to 13,000 euros per car. The initiative was well received, with more than 90,000 applications for 25,000 available slots. The profile of the policy recipients has been documented to be aligned with the program's goal of increasing the pool of BEV users, enabling economically vulnerable groups, including younger and lower-income individuals, to access BEVs. Observers, particularly T&E, have suggested creating a European Platform for Social Leasing to streamline the process.[9] Such platform, according to T&E, would negotiate contract terms

---

[6] More information on the relationships between BEVs adoption and income per capita can be find at: https: //www.acea.auto/press-release/electric-cars-lower-income-countries-fall-behind-with-uptake-linke d-to-gdp-per-capita/.

[7] See for instance in the Sole24, the Italian financial newspaper at: https://www.econopoly.ilsole24ore.com/.

[8] Production cost reductions are achieved by scaling up, and thus by larger markets. In general, economic studies confirm that the propensity to consume decreases with income, and that the wealthier classes spend less in terms of income shares on consumption of durable goods. Mass production has always been the epitome of lowering production costs, along with then just-in-time inventory management. This implies that cost-cutting comes not from purchases by the wealthiest but by the majority of consumers.

[9] The T&E report on social leasing can be found at: https://www.transportenvironment.org/uploads/files/2024_10_Social_leasing_briefing_2024-11-08-085405_xpvl.pdf.

with OEMs, including pricing, duration, and vehicle types. Additionally, it could act as a form of public procurement to support the production of small BEVs within Europe. While the French model offers valuable insights, the scheme relies heavily on public expenditure and credit-driven financing scheme. Considering that the policy is based on public expenditure, it is important to monitor the policy's effectiveness in genuinely improving BEV accessibility to low- and middle-income consumers.

4.1.3 Development contracts

Introduced in Italy in 2008, development contracts are public support mechanisms to private firms, single or in consortium, aimed at encouraging large-scale and strategic private investments. The program is managed by INVITALIA (*Agenzia Nazionale per l'attrazione degli Investimenti e lo Sviluppo d'Impresa*), Italy's national agency for economic development, promoting investment, innovation, and job creation, which manages financial incentives and supports businesses, especially in strategic sectors and underdeveloped areas. To qualify for the development contracts programme, investments must exceed 20 million euros and demonstrate the potential to generate employment, enhance the positioning in international markets and global value chains, foster environmental sustainability, and promote technological innovation. The programme extends to sectors like the agri-food industry, which, by looking at the financing recipients, in the last years has been overrepresented, especially by players active in food production, conservation and packaging. The automotive sector has been underrepresented among recipients, with a few exceptions such as Ferrari (data are available in the "Report" section of the MIMIT webpage).[10] The defense industry has also benefited from the scheme. While development contracts support supply-side investments and embed some aspects of conditionality, they are not targeted towards the development of specific technologies and/or processes. So far, they looked to be more suited for rebuilding the capital stock of existing firms during stable times rather than sustaining an entire industry in structural crisis like that facing the automotive industry. However, some recent initiatives started with the PNRR framework in 2022 specifically target the generation of renewable energies and batteries, microprocessors and electrical buses, going toward the direction of more specific technology-oriented support schemes.

---

[10] More information can be retrieved at: https://www.mimit.gov.it/it/incentivi/contratti-di-sviluppo.

4.1.4 Strategic Sectors – Libro verde (MIMIT)

In November 2024, the Ministry of Enterprises and Made in Italy (MIMIT, previously and traditionally known as the Ministry of Economic Development) released the *Libro Verde*, a new industrial policy framework for Italy. This policy aims to reorient Italy's economic strategy by balancing traditional goals, such as industrial competitiveness and regional cohesion, with new meta-targets. In particular, four objectives are identified, namely: i) contrasting deindustrialization, ii) investing in the green transition, also including nuclear energy, iii) introducing critical technologies able to produce "discrete jumps" in productivity, and iv) ensuring security in the access to critical materials, energy autonomy and industrial sovereignty. The *Libro Verde* identifies the automotive sector as strategic, highlighting its strengths and vulnerabilities, with particular emphasis on the reliance on a single OEM and a supply chain dominated by small and medium enterprises that act as suppliers for foreign OEMs. According to the book, the delay towards BEV production across Europe has exacerbated declining demand for parts and components, putting additional strain on Italy's supply chain. Currently, this represents a framework for stakeholder discussion in preparation for the final policy guideline "Libro Bianco". However, the present version lacks specifics regarding instruments, responsible actors, or funding amounts, a lacuna that will possibly be addressed in the following steps.

4.1.5 European industrial policies

With the Green Deal strategy, the European Union has advanced and promoted a set of Acts and interventions meant to foster the decarbonization transition. Below we discuss some of the most significant among these initiatives. The European strategy has more recently reoriented the objective of decarbonization towards economic security, especially following disruptions like the COVID-19 pandemic and the semiconductor crisis that highlighted production bottlenecks and shortages. The reorientation towards economic and energy security has led to a new framework, Open Strategic Autonomy, that prioritises reducing dependency on foreign energy and critical raw materials. Under the Open Strategic Autonomy framework, the European Battery Alliance, launched by the European Commission in 2017, aims to establish a domestic battery supply chain. Autonomy in battery production would allow European OEMs to become independent and avoid the acquisition of parts and components from foreign, mainly Chinese, players. Nevertheless, the effective functioning of the alliance is still unclear. In the last two years many gigafactory projects were launched by European

OEMs and parallel players, but they have yet to materialize, leaving battery production heavily reliant on East Asian manufacturers.

Finally, in 2024 a plan in support of the automotive, referred to as a "SURE for the Automotive Sector," has been launched.[11] The plan calls for a €500 billion EU investment to support the automotive industry, protect jobs, and promote a sustainable transition. However, as of today, this initiative remains in the policy proposal stage.

4.2 A proposal of industrial policy for the automotive industry: targets, instruments, institutions

The reviewed schemes and initiatives suffer from the lack of a systematic approach to tackle the crisis of the automotive industry. In the following, we propose an integrated framework to address multi-target objectives via a multi-dimensional set of instruments. In particular, Table 7 presents a set of hierarchically structured policies, that can represent a possibility of a new articulation of industrial policies. The table proposes a specific plan for the automotive sector, elaborating upon the scheme of industrial policies presented in Dosi et al. (2024) and Cimoli et al. (2009). The general policy scheme, identifying targets, instruments and institutions is presented in the Appendix, while the specific application vis-à-vis the automotive industry is presented below.

In the following we discuss each element of the policy scheme in detail.

4.2.1 Mission-oriented policies

Mission-oriented policies have been historically focused on long-term development objectives to be achieved through the generation of frontier knowledge, science, and technology (Mazzucato, 2018). Initially tied to defense and space targets—such as the archetypical mission of sending humans to the moon (Nelson, 1974)—the scope of these industrial policies has since expanded to address societal challenges, particularly during a period of poly-crises. Progressively, the technological-fix approach has proven insufficient for solving societal problems. Policymakers now face the challenge of crafting plans that integrate technological advancements with societal goals. However, such plans must be specific and clearly identify objectives. This is of paramount importance to define mid-term

[11] More information on the "SURE for the Automotive Sector" proposal can be found at: https://www.eunews.it/en/2024/12/10/yes-to-green-transition-no-to-military-transition-conte-calls-for-a-500-billion-eu-automotive-fund/.

deliverables, but also processes of measure and quantification of the achievements and outcomes (Cimoli et al. 2009; Mazzucato, 2018).

Within this framework, achieving the decarbonization transition and meeting the target of net-zero emissions in mobility are the ultimate objectives of the proposed policy scheme. The Green Deal and the Inflation Reduction Act have been two tentative programs in such direction.

A mission-oriented approach to mobility will imply achieving the target of decarbonization while allowing people to move, maintaining their jobs, and potentially improving their standard of living in terms of both working and environmental conditions. Decarbonizing mobility requires rethinking the roles of both public and private transportation. A mission-oriented approach envisions a public plan for R&D investments in frontier technologies compatible with emission reduction, including recyclable and non-lithium batteries, such as sodium-ion or solid-state batteries. Additionally, a public R&D plan should invest in alternative technological solutions, particularly green hydrogen, which may find limited use in HDVs and which, more usefully, should be employed in the hard-to-abate sectors of transportation.

To support the development of scientific knowledge needed for the decarbonization of mobility, universities, public laboratories, the CNR, and competence centers should be mobilized. Scientific alliances should be fostered, with interdisciplinary collaborations between engineering, chemistry, and physics departments aimed at achieving the grand societal goal. Learning curves remain steep, and without significant investments in technological innovation, overcoming price barriers and enabling the mass adoption of alternative technologies to fossil-fuel-powered vehicles will not be feasible. To promote the diffusion of new electric vehicles, public procurement can serve as an effective channel. Both the purchase of public electric vehicles and initiatives like social leasing, where the Government acts as a contractor, represent effective ways to push coordinated and large scale demand.

The domain of mission-oriented policies lies in the realm of scientific knowledge, where the responsible institutions should include public laboratories, universities, and the State. A specific agency should control the development of the industrial strategy, acting in essence as a national agency with capacity for spending, setting objectives, coordinating actions, but also providing support and training to other actors. This agency should be the ultimate authority for industrial policies, in coordination with the Government and the European Commission, integrating scientific and technical knowledge with societal and political knowledge.

4.2.2 Sectoral – vertical – industrial policies

According to the linear model of innovation (Balconi et al., 2010), vertical industrial policies are the primary propagation channel for translating the results and achievements of mission-oriented policies, as they foster the trickle-down of scientific advancements and science into technological and industrial applications. These should be vertical policies, targeted at specific industries or sectors. For example, promoting training programs and academies that cultivate skills and competencies for the decarbonization paradigm is crucial for the success of electro-mobility. Retraining and training schemes are urgently needed to develop the full range of capabilities—from electrical engineers to production workers—and should be implemented within private firms, both OEMs and suppliers. A lack of competences may in fact create bottlenecks in production and the introduction of new models. Professional schools, in collaboration with trade unions and business associations, might develop *ad hoc* apprenticeship programs focused on decarbonizing mobility.

Vertical industrial policies should also support R&D activities within private firms to develop and industrialize new technologies. Collaborations with national agencies can create common platforms for exchanges and advancements in industrial applications. Moreover, specific greenfield public investments, such as the creation of a public national gigafactory, could help fostering and scaling up production capacity. Vertical industrial policies contemplate the possibility of a direct intervention of the State in the ownership structure of private firms. For the automotive sector, in light of the collapse of Stellantis and the lack of strategic investments in Italy, a golden share in the ownership structure might provide the state with a tool for intervention in setting the direction of the industry. The state's involvement in private firms could activate conditionalities tied to the scale and the amount of the public investments received. Conditionality may in fact imply that if public transfers are received, for example to sustain R&D, investments, training programs, private firms should be compliant to some specific requirements, in particular employment guarantees, quality of industrial and labour relations, environmental sustainability programs, and lack of offshoring. In essence, these conditionalities serve as disciplining mechanisms (Amsden and Singh, 1994), ensuring that the receipt of public funding aligns with societal goals. Institutions responsible for vertical industrial policies should include the Ministries of Economics and Finance, Economic Development, and national investment banks, such as *Cassa Depositi e Prestiti* and the European Investment Bank. These actors should coordinate with the national agency for industrial policy.

4.2.3 Technological – Horizontal – Industrial Policies

Technological horizontal industrial policies target the adoption and diffusion of technologies rather than their development, acting horizontally across actors, sectors, and, with reference to the automotive industry, along vertically integrated industries. These policies should foster the development of competencies and capabilities within private firms and technological clusters. For example, territorial, geographical, and technological alliances could be promoted under horizontal industrial policies. Schemes like management and entrepreneurship training programs can help small and medium-sized enterprises (SMEs) develop internal complex capabilities, regardless of their size, enabling them to adapt and thrive in an evolving landscape marked by deep transformations (Costa et al., 2023). An example of technological industrial policies in Italy is the recent Industria 4.0 plan, which offers fiscal incentives for investments in digital and automated technologies. While horizontal industrial policies like these support firms already capable of navigating the landscape via reducing investment costs, the real need is for latecomers and lagging-behind firms to access new knowledge generation, development plans, and especially target long-term objectives. In this respect, building a robust and resilient Italian value chain for electric mobility is a key objective of horizontal policies. Institutions responsible for horizontal industrial policies should include the Ministries of Economics and Finance, Economic Development, and entities coordinating with European Alliances, such as the European Battery Alliance. With the aim of identifying needs and overcoming bottlenecks, business associations and trade unions, that have a sector-wide perspective of the articulation of the production chain, should also be involved in designing horizontal industrial policies aimed at the diffusion and adoption of new technologies, processes, and relations with actors.

4.2.4 Market regulation policies

Market regulation policies aim to regulate the functioning of markets, with particular attention to input prices. A framework of industrial policies designed to sustain domestic automotive vehicle production should regulate energy costs, working in tandem with the national energy strategy. For instance, decoupling the price of renewable energy from natural gas (Weyman-Jones, 2023) or even creating separate markets for renewable and non-renewable energy sources could promote price stability. The energy strategy should also prioritize increasing investments in renewable energies, including hydrogen production, to boost supply and avoid bottlenecks. The Ministry of Energy Security should collaborate and formulate plans in accordance with the Ministry of Economic Development (MMIT) with the common agenda of firstly regulate the energy prices and secondly to expand the supply of renewable energy sources. Decarbonizing mobility should in fact be coupled and proceed in parallel with a decarbonization of energy generation.

4.2.5 Institutional Architectures

The current societal challenge is not merely another technological transformation but rather a potential reconfiguration of the socio-economic system toward new forms of mobility and energy generation. This moment represents a clear break from the past, with new needs, actors, and interests emerging. An industrial policy capable of addressing the transition to decarbonized mobility must incorporate input from civil society. In particular, the policy framework should aim to prevent further harm to vulnerable segments, such as workers impacted by the transition and communities facing environmental degradation or socio-economic insecurity. Income and employment guarantees should be paired with the right to live in healthy territories, ensuring that no employment-health trade-offs emerge (Bez and Virgillito, 2024). Policies should be just and equitable, adhering to social, environmental, and climate justice principles, and should maximize benefits for the majority. In this respect, it is crucial to create new institutional architectures able to integrate civil society, trade unions, social alliances, and social movements. Initiatives like external observatories should be established to measure, monitor and guide political institutions towards social justice. Emerging experiences, such as the *Alleanza Clima Lavoro*,[12] propose an alliance for decent jobs and a healthy environment, focusing on the costs of inaction suffered by workers.

[12] More details on the "Alleanza clima lavoro" can be found at: https://sbilanciamoci.info/la-scure-del-governo-si-abbatte-sullautomotive/.

Table 7: Hierarchically structured industrial policy plan for the automotive sector.

TARGETS	INSTRUMENTS	INSTITUTIONS
	MISSION ORIENTED POLICIES	
Decarbonisation transition - Public mobility - Entry in new productions	Public plan of R&D investments for frontier technologies	Polytechnic Universities, Public research centers (such as the Italian *CNR*), Competence centers
Diffusion of new mobility forms	Public procurements	Ministry of Transport and Infrastructure
	SECTORAL - VERTICAL - INDUSTRIAL POLICIES	
Acquisition of a widespread set of competences on electric mobility, battery and hydrogen production	A national (re)training agency/academia	Professional schools, business associations
	(Apprenticeships, learning on the job)	Trade unions
Structure, ownership	Italian golden share in Stellantis, conditionality clauses	Ministry of Treasury, *Cassa Depositi e Prestiti*
	TECHNOLOGICAL - HORIZONTAL- INDUSTRIAL POLICIES	
Activation of supply chain effects	R&D policies, alliances, territorial clusters	Ministry of Made in Italy, European Battery Alliance
	MARKET REGULATION POLICIES	
Containment of energy prices and secure production inputs	Energy policy strategy	Ministry of Energy Security (PNIEC)
	INSTITUTIONAL ARCHITECTURES	
Governance and regulation of conflictual interests	Policies for social justice, environmental justice, climate justice	Alleanza clima/lavoro, Industrial policy observatories

5 Conclusions

This paper assesses the cost of inaction faced by the automotive sector, and more broadly, by the Italian economy, if alternative pathways, beyond the current “business-as-usual” scenario, are not pursued. We present a simulated model of the Italian economy, mapping the dynamics of the automotive industry and its supply chain when impacted by an external demand shock. The model aims to capture the economic and social losses resulting from the lack of a transition to electric mobility. It projects the economy from 2021 to 2030, simulating non-linear cumulative shocks at each time step while adjusting for policy interventions. Initial shocks affect final demand, value added, and employment multipliers in year $t + 1$, which propagate through subsequent years via reduced consumption, lower employment, and diminished value added. These shocks reflect contractions in automotive demand and their cascading impacts on employment and economic output, as based on the real figures of the Italian economy. Demand for cars in a given year is modelled as a function of the previous year’s demand, adjusted for historical growth or contraction rates. Employment and value added multipliers, which represent jobs or output generated per unit of production, are dynamically updated over time. The model also integrates the effects of passive policy interventions, particularly the Italian *Cassa Integrazione Guadagni* (CIG) redundancy scheme. The greater the fiscal stimulus, the lower capacity the system has to absorb employment shifts to other sectors of the economy. The fiscal cost of the CIG scheme is estimated by combining the number of workers covered, their average wages, and the subsidy rate. The model outlines three policy scenarios to analyse the effects of demand shocks in the automotive sector, assuming a structural unemployment rate of 5% for the sector and varying re-employment rates in other sectors for automotive workers—thus accounting for re-employed workers’ contributions to demand while adjusting for demand mitigated by wage subsidies.

We estimate that the cumulative cost of inaction, through the financing of the CIG scheme, ranges from five hundred million to two billion euros, depending on the scenarios analysed. Recently, it has been estimated that the Italian OEM, Stellantis (formerly FCA), received almost one billion euros in CIG transfers over ten years from the State, approximately 700 of which received from 2021 to 2024.[13] Despite this massive financing, the firm has repositioned its core production abroad, and there is

[13] See, e.g.: https://www.corriere.it/economia/lavoro/24_dicembre_04/cassa-integrazione-stellantis-all o-stato-e-costata-700-milioni-in-tre-anni-a-rischio-altri-12-mila-posti-ef29366c-127d-4493-aa81-6 b2fc238fxlk.shtml.

no clear indication of a strategic reorientation. Stellantis has progressively phased out, with continuous reductions in car production and employment, and a dramatic lack of new models, especially BEVs in the affordable segments A, B, and C. Italy appears ill-equipped to counteract Stellantis' progressive downsizing and dismissal. The only tool to actively respond is the Fund for the Automotive Industry, which was established in 2022 with an endowment of around 8.7 billion euros. A portion of this fund—almost one-third—has been allocated to finance demand incentives, primarily for internal combustion engine endothermic vehicles. The fund's endowment, precisely while Stellantis is undergoing its largest crisis, has been dramatically reduced. Against this backdrop, it is urgent to identify a clear direction to prevent the collapse of the sector. According to the authors, a potential investment of one billion euros per year to finance the framework of industrial policies above outlined could provide medium-scale financing capable of overcoming the cost of inaction. Further reductions in the fund will not support the industry. Massive layoffs are imminent, and strategic solutions remain lacking. Moreover, this is not only a problem for Stellantis but also for its entire network of suppliers in manufacturing and services. Finally, other European final OEMs are reducing car production, leading to a decrease in demand for parts and components. It is crucial to urgently address the crisis of the European automotive industry with coordinated policy actions among member states. More than 13 million workers are directly or indirectly employed in the sector, and the negative effects could result in large, undesirable social outcomes.

References

Aaronson, S. R., Daly, M. C., Wascher, W. L., & Wilcox, D. W. (2019). Okun revisited: Who benefits most from a strong economy?. *Brookings Papers on Economic Activity*, *2019*(1), 333-404.

Amsden, A. H. and Singh, A. (1994). The optimal degree of competition and dynamic efficiency in Japan and Korea. *European Economic Review*, 38(3-4):941–951.

Balconi, M., Brusoni, S., and Orsenigo, L. (2010). In defence of the linear model: An essay. *Research Policy*, 39(1):1–13.

Bez, C., & Virgillito, M. E. (2024). Toxic pollution and labour markets: uncovering Europe's left-behind places. *Review of Regional Research*, *44*(3), 337-381.

Cimoli, M., Dosi, G., Nelson, R., and Stiglitz, J. E. (2009). 192 Institutions and Policies Shaping Industrial Development: An Introductory Note. In *Industrial Policy and Development: The Political Economy of Capabilities Accumulation*. Oxford University Press.

Costa, S., De Santis, S., Dosi, G., Monducci, R., Sbardella, A., and Virgillito, M. E. (2023). From organizational capabilities to corporate performances: at the roots of productivity slowdown. *Industrial and Corporate Change*, 32(6):1217–1244.

Cresti, L., Dosi, G., Riccio, F., and Virgillito, M. E. (2023). Italy and the trap of GVC downgrading: labour dependence in the European geography of production. *Italian Economic Journal*, 9(3):869– 906.

Dosi, G., Cresti, L., Riccio, F., and Virgillito, M. E. (2024). Industrial policies for global commons: why it is time to think of the ghetto rather than of the moon. Technical report, Laboratory of Economics and Management (LEM), Sant'Anna School of Advanced Studies.

Mazzucato, M. (2018). Mission-oriented innovation policies: challenges and opportunities. *Industrial and corporate change*, 27(5):803–815.

Miller, R. E. and Blair, P. D. (2009). *Input-output analysis: foundations and extensions*. Cambridge University Press.

Nelson, R. R. (1974). Intellectualizing about the moon-ghetto metaphor: A study of the current malaise of rational analysis of social problems. *Policy Sciences*, 5(4):375–414.

Okun, Arthur M. 1973. “Upward Mobility in a High-Pressure Economy.” Brookings Papers on Economic Activity, no. 1, 207–52. https://www.brookings.edu/ wp-content/uploads/1973/01/1973a_bpea_okun_fellner_greenspan.pdf.

Weyman-Jones, T. (2023). Energy Price Decoupling and the Split Market Issue. *Energies*, *16*(16), 5910.

Appendix A – Input-Output Methodological Framework and data

We take symmetric industry-by-industry Input-Output tables Z from the OECD Inter-Country Input-Output (ICIO) Tables (2023 Release) which include 76 countries (+ Rest of the World aggregate) and 45 sectors, from 1995 to 2020. Information on sectoral employment is drawn from OECD Trade in Employment (TiM) database, while value added is drawn from OECD Trade in Value Added (TiVA) database.

We exclude some developing and emerging economies from the I-O table in order to match the availability of TiM's and TiVA's employment and value added vectors and construct the multipliers matrices. All variables are provided at 2-digit level of aggregation based on the International Standard Industrial Classification of all economic activities, Revision 4 (ISIC Rev. 4) and are measured in millions of USD, current prices. Below we describe the steps of algebraic transformations required to construct the employment multipliers matrix. The same technique can be applied for the value added multipliers matrix. After having accessed the input-output matrix of intermediate deliveries, *Z*, we construct the matrix *A* of direct inter-industry coefficients, post-multiplying *Z* by the inverse of the diagonal matrix of sectoral output $\hat{x}$:[14]

$$\boldsymbol{A} = \boldsymbol{Z}\hat{x}^{-1}$$

where the hat symbol refers to diagonalized matrices. Every element a_{ij} of matrix *A* stands for the technical coefficient of the input produced by industry *i* and sold to industry *j*, that is the intermediary amount z_{ij} over the total gross output x_j. Matrix *A* is used to solve the accounting equations, describing the economic system composed by *N* industries, each producing a homogeneous good, represented as a vector of gross output *x* which equals a vector of intermediate production *Zi* and a vector of final demand *d*:

$$x = \boldsymbol{Z} + d$$

$$x = \boldsymbol{A}x + d$$

Solving by *x* yields:

[14] The hat over variables stands for the transformation from vector to diagonalized matrix.

$$(\boldsymbol{I} - \boldsymbol{A})x = d$$

$$x = (\boldsymbol{I} - \boldsymbol{A})^{-1}d$$

The first element on the right-hand side is called the Leontief Inverse matrix,

$$\boldsymbol{L} = (\boldsymbol{I} - \boldsymbol{A})^{-1}$$

where $\boldsymbol{I}$ represents the identity matrix and we assume that the inverse of $(\boldsymbol{I} - \boldsymbol{A})$ exists. Considering N industries with $i,j = 1,...,N$, every $l_{i,j}$ element of the standard Leontief matrix ($\boldsymbol{L} = (\boldsymbol{I} - \boldsymbol{A})^{-1}$) captures the direct and indirect requirements of increased output of industry i needed to produce one additional unit of final good in industry j. Capturing direct and indirect inputs stands exactly for the attempt to include the entire amount of intermediaries each sector is providing to another one. That is, we track not only the flow of inputs produced by a sector i and delivered directly to sector j, but also the flow of inputs still produced by sector i, but used by other sectors to produce in turn the intermediaries then provided to the same sector j. The Leontief matrix allows for the construction of the matrix of direct and indirect labour contributions of each sector to produce the goods in the economy activated by one more unit of final good:

$$\boldsymbol{E} = \hat{l}\,\hat{x}^{-1}\boldsymbol{L}$$

Where $\hat{l}$ is the diagonal matrix of sectoral employment which, divided by $\hat{x}$, the diagonal matrix of sectoral output, results in a diagonal matrix of technical labour coefficients. Every cell of matrix $\boldsymbol{E}$ captures the so-called employment multipliers, i.e. the amount of employees activated in each country-industry of the supply chain – which can be called subsystem – by a fixed amount of final demand (in our case 1 million USD). $\boldsymbol{E}$ is a country-industry × country-subsystem matrix, built for every year from 1995 to 2020.

The columns of this matrix are defined as production subsystems and represent the chains or induced activities activated by the production of final goods. The assumption that this approach entails is that employees belonging to a standard sectoral classification are "embodied" in intermediate trade flows. When looking at the main diagonal of the matrix, one observes the demand for labour inputs (i.e., the employment multiplier) generated internally – or *directly* – within the same industry. In addition, it is possible to identify the multipliers in other branches of the economy, generated from the same subsystem j. These external, or *indirect* multipliers can be distinguished into *domestic*, if the sector i in which the employment is generated belongs to the same country of subsystem j (that is Italy in our case), or *foreign* if the opposite holds.

We can compute three measures of employment multipliers for each Italian automotive subsystem j:[15]

- Direct Multiplier: Employees activated by the Italian subsystem j in the respective industry j:

$$Direct_j = e_{jj}$$

- Domestic Indirect Multiplier: Employees activated by the sum of Italian subsystem j's multipliers over Italian industries excluding the respective one, j. This multiplier can be interpreted as a measure of outsourcing of productive processes out of the sector but within the domestic economy. Here we omit the subscript c as it is only referred to Italy:

$$DomesticIndirect_j = \sum_{i=1}^{n} e_{i,j}$$

- Foreign Indirect Multiplier: Employees activated by the sum of Italian subsystem j's multipliers over foreign industries. This multiplier can be seen as a measure of offshoring of production processes abroad. Here the subscript c is necessary as we refer to all available countries except Italy:

$$ForeignIndirect_j = \sum_{i=1}^{n} e_{i,j}$$

The same approach can be applied with a vector of value added to obtain a matrix of value added multipliers. We focus on the subsystem aimed at the production of Italian automotive as final good and investigate the dynamics of employment and value added for the direct and domestic indirect

[15] Note that the use of the notion of *direct* versus *indirect* is different from the one usually adopted in Input-Output analysis to describe the direct and indirect coefficients of the Leontief Inverse. Additionally, in the employment multipliers matrix every cell contains the direct and indirect labour coefficients. What we do here is to distinguish different parts of the supply chain, in order to have an internal/within the sector (direct) component and an external/out of the sector (indirect) one (which in turn is composed by domestic and foreign sub-parts).

components of the value chain. In particular, we exploit the times series to compute averages growth of key variables and then the levels of year 2020 as starting period for the simulation.